

ELLIOTT

903

- Volume 1: FUNCTIONAL SPECIFICATION
- Part 2: THE BASIC 903 COMPUTER UNIT
- Section 6: PAPER TAPE AND TELEPRINTER EQUIPMENT

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Appendix 1: LIST OF CODES

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Section 1. 2. 6 - PAPER TAPE AND TELEPRINTER EQUIPMENT
INFORMATION BULLETIN NUMBER 1

This Section should be altered in accordance with the information contained in this Bulletin. The Bulletin should then be inserted after page ii in Section 1. 2. 6.

Page	Reference	Information
1 (Issue 2)	1. 1 line 18/19	Insert new paragraph as follows: "NOTE: A 500 character per second paper tape reader is available as a special option instead of the 250 character per second model".

4 (Issue 2)	2. 1	Insert the following paragraph at the end of Para. 2. 1
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"A 500 character per second paper tape reader may be used as a special option which is identical to the 250 character per second model in all respects except for its speed of operation. Two character buffers (see Para. 2. 2) are, however, fitted with the faster reader".

Appendix 4 1 (Issue 1)	Third Paragraph	Amend last sentence to read as follows:
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"When in the "on-line" mode, if a device is addressed when it is busy, then the characters input to the processor are undefined, and any characters output (including the character which caused the device to become busy) may be corrupted or lost".

Chapter 1: GENERAL INFORMATION

1.1 Introduction

This section describes the 903 Paper Tape and Teleprinter Equipment that, together with the central processor and the 8192 word store form the basic Elliott 903 Computer.

The paper tape and teleprinter equipment provides a means of inputting information to, and receiving information from, the central processor. Depending on the type and quantity of information to be transferred, and the speed required, a system may include:-

- (a) Teleprinter only
- (b) Paper tape reader and punch
- (c) Teleprinter and paper tape equipment.

The controller which provides the logic and power supplies for the equipment is mounted in a standard 19 inch rack which fits into the 903 desk.

The paper tape equipment consists of a 250 character per second paper tape reader and a 110 character per second paper tape punch, both of which are mounted on the 903 desk.

The teleprinter is mounted on its own stand. A 10 character per second paper tape reader and a 10 character per second paper tape punch are incorporated in the teleprinter. It is stressed that these items are integral parts of the teleprinter unit. They are referred to throughout this section as the 'printer reader' and the 'printer punch' to avoid confusion with the reader and punch which comprise the paper tape equipment.

The operator's switches and lamps associated with the paper tape reader, paper tape punch and teleprinter are mounted on the tape and teleprinter Control Panel which is housed in the top of the 903 desk along the front edge.

Details of the 903 standard interface facilities for the paper tape and teleprinter equipment will be given in Section 1. 2. 7.

The power supplies and environmental conditions required for this equipment are given in Section 1. 2. 9.

1.2 Instruction Code

The input and output instructions for the paper tape and teleprinter equipment are given in the next two subsections. For a more detailed description of 903 program instructions see Section 1.2.2.

1.2.1 Paper Tape Instruction Code

The instruction to input a character via the paper tape reader is

15 2048

When this instruction is obeyed the present contents of the accumulator are shifted left seven places and then an 8-bit character from the tape reader is read into the least significant 8 bits of the accumulator. The new accumulator bit 8 will be zero if, and only if, both the paper tape bit 8 is zero and the old accumulator bit 1 was zero.

The instruction to output a character to the paper tape punch is

15 6144

When this instruction is obeyed the 8 least significant bits of the accumulator are output to the paper tape punch causing a character to be punched on tape.

1.2.2 Teleprinter Instruction Code

The instruction to input a character via the teleprinter is

15 2052

When this instruction is obeyed, the present contents of the accumulator are shifted left seven places and then an 8-bit character is read from the teleprinter into the least significant 8 bits of the accumulator. The new accumulator bit 8 will be zero if, and only if, both the teleprinter bit 8 is zero and the old accumulator bit 1 was zero.

The instruction to output a character to the teleprinter is

15 6148

When this instruction is obeyed the 8 least significant bits of the accumulator

are output to the teleprinter and printed.

1. 3 Channel Selection

1. 3. 1 General

Mounted on the Control Panel are two input/output selection switches; the SELECT INPUT switch is labelled READER/AUTO/TELEPRINTER and the SELECT OUTPUT switch, TELEPRINTER/AUTO/PUNCH. When the SELECT INPUT switch is in the AUTO position the input instructions described in subsections 1. 2. 1 and 1. 2. 2 are obeyed as stated. Similarly, when the SELECT OUTPUT switch is in the AUTO position the output instructions described in subsections 1. 2. 1 and 1. 2. 2 are obeyed as stated.

When the switches are set to other positions the effect is as described in subsections 1. 3. 2 and 1. 3. 3 below.

1. 3. 2 Input Instructions

When the SELECT INPUT switch is set to the TELEPRINTER position, all input instructions for the paper tape and teleprinter unit are diverted to the teleprinter. Thus, while the switch is in this position, it is not possible to read characters from the paper tape reader.

When the switch is in the READER position all input instructions are diverted to the paper tape reader.

1. 3. 3 Output Instructions

When the SELECT OUTPUT switch is in the TELEPRINTER position all output instructions are diverted to the teleprinter.

When this switch is in the PUNCH position all output instructions are diverted to the paper tape punch.

1. 3. 4 Notes on Restricted Systems

In a system where no paper tape reader and punch are supplied all instructions are automatically diverted to the teleprinter no matter how the SELECT INPUT switch (or the SELECT OUTPUT switch, as the case may be) is set. Similarly for a system where no teleprinter is supplied, all instructions are diverted to the paper tape reader and punch.

Chapter 2: PAPER TAPE EQUIPMENT

2.1 Introduction

The Paper Tape Equipment comprises a 250 character per second reader and a 110 character per second punch. The logic and power supplies for reader and punch are provided in the paper tape controller which is housed in the 903 desk. In this chapter the reader and punch will, for convenience, be described separately.

The weight and dimensions of the tape reader and tape punch are given in subsection 2.4. Details of the paper suitable for use with the paper tape equipment are given in Section 3.1.2 of this manual.

2.2 Paper Tape Reader Facilities

Characters are read from the paper tape reader into an eight bit buffer. The read tape instruction (see subsection 1.2.1) causes the contents of this buffer to be transmitted to the central processor.

Eight track tape is normally used but it is also possible to use tape with five or seven tracks. An eight-bit character is always transmitted from the buffer to the main accumulator. If five or seven-track tape is used, the state of the bits corresponding to the absent tracks will be undefined.

2.2.1 Mode of Operation

To initiate reading from tape the READ button on the control panel must be depressed. This causes the tape to be advanced until the leading edge of the next sprocket hole is detected. At this point the clutch is de-energised, the buffer is loaded and the tape stops with the loaded character under the light. When a read tape instruction is given, the contents of the buffer will be read to the computer, the tape will be advanced to the next character and the buffer will again be loaded.

2.2.2 Reader Controls

Controls for the paper tape reader are mounted on the control panel. They are described in Table 1 below. In addition, two controls are mounted on the paper tape reader itself. These are:

- (1) the ON-OFF switch which switches the tape reader motor on or off as desired

and (2) the RUNOUT control. This is a white button which, when depressed, causes tape to be fed through the reader at high speed without being read to the central processor. Depression of this button unloads the reader buffer and causes a creep error condition.

Table I Controls For The Paper Tape Reader

Name	Description	Lamp is lit when	Effect of depressing button	Notes
READ	White push button incorporating a blue lamp	<p>any of the following conditions are true:-</p> <p>(1) No tape is present in the paper tape reader</p> <p>(2) the RUNOUT button mounted on the reader itself is operated</p> <p>(3) the occurrence of creep error i. e. when a character in the buffer has been overwritten by a second character before the processor has accepted the first.</p> <p>This lamp is extinguished when the READ button is depressed.</p>	<p>The tape in the paper tape reader is advanced until the leading edge of the next sprocket hole is detected, at which point the clutch is de-energised, the buffer is loaded and the tape stops with the loaded character under the light.</p>	<p>A read tape instruction is held up while the READ lamp is lit.</p>

Table 1 Controls for the Paper Tape Reader (Cont'd)

Name	Description	Lamp is lit when	Effect of depressing button	Notes
STOP	White push button incorporating a yellow lamp	the STOP button has been depressed. It is extinguished when the READ button is depressed.	Stops tape being read. If this button is depressed when the buffer is empty, the buffer is loaded and then the reader stops so that the character under the reader lamps is the one in the buffer. If this button is depressed when the buffer is full, the buffer contents are unchanged and the reader stops so that the character under the reader lamps is the one in the buffer.	Depressing this button when the READ lamp is lit will have no effect.
HOLDUP	White control incorporating a red lamp	the 903 processor is held up on a tape read instruction i. e. when the READ lamp is lit as a result of the conditions above being true. It is lit if the SELECT INPUT switch (see subsection 1. 3) is set to READER and an instruction to read a character from the teleprinter is held up.		

2. 3 Paper Tape Punch Facilities

An eight-bit character is sent to the punch in response to a punch tape instruction (see subsection 1. 2. 1). If 5 or 7 track tape is to be used then the bits of the character corresponding to the absent tracks must be zero. The character is held in an eight-bit buffer until it can be punched.

The punch motor will be switched off if no character is sent within approximately 4 seconds of the previous character being punched. Should the tape punch motor be off when a punch tape instruction is given then, although the instruction is accepted immediately, the tape punch control will be busy for 1 second while the tape punch motor restarts and accelerates to full speed.

The weight and dimensions of the punch are given in subsection 2. 4.

2. 3. 1 Controls

The controls associated with the paper tape punch are mounted on the control panel. They are described in Table 2 below.

Table 2 Controls for the Paper Tape Punch

Control	Description	Lamp is lit when	Effect of depressing button	Notes
RUNOUT	Non-locking white push button		The tape punch feeds blank tape.	
RELOAD	Non-locking white push button incorporating a blue lamp	the 'low-tape' contacts on the paper tape punch operate. The lamp remains lit and instructions to the punch are held up until the 'low-tape' condition is cleared (i. e. until another reel of tape is loaded), and the RELOAD button is depressed.	Pressing this button when the lamp is lit will cause the lamp to be extinguished provided that the low-tape condition has been cleared. The low-tape condition may be over-ridden by keeping the RELOAD button depressed.	The RUNOUT button remains operative when the RELOAD lamp is lit.

2. 4 Weight and Dimensions

The table below gives the weight and dimensions of the paper tape reader and punch.

	Weight (approx)		Height		Depth		Width	
	kg	lb	cm	in	cm	in	cm	in
Reader	7.6	17	24.8	10.0	23.5	10.5	15.6	6.2
Punch (in a sound- proof box)	22.5	50	33	13.75	48.3	19	25.4	10

Chapter 3: TELEPRINTER UNIT

3.1 Introduction

The Teleprinter Unit consists of a teleprinter, a paper tape punch and a paper tape reader, the complete unit being mounted on its own stand. The reader and punch are referred to in this section as the 'printer reader' and 'printer punch' to distinguish them from the paper tape reader and paper tape punch described in Chapter 2.

The teleprinter unit enables the operator to control the running of a program by inputting information to, and receiving information from, the central processor. Information may be sent to the processor via the keyboard on the teleprinter or by means of the printer reader. Output information is always printed on the teleprinter and may also be produced on tape by means of the printer punch. All characters input are automatically re-output and consequently printed and, if required, punched.

Both printer reader and printer punch operate at a maximum speed of 10 characters per second. It is not recommended that the punch be used for large amounts of data.

A standard copy holder is fitted above the keyboard and a chad box to collect the chads produced by the printer punch is attached to the left hand side of the unit.

3.2 Teleprinter Facilities

The controller incorporates an eight bit buffer which can be used for input and output via the teleprinter. The buffer may at any time be empty, busy or full.

3.2.1 Input

If a key is struck or a character is sent from the printer reader when the buffer is empty, then the character bits will be loaded into the buffer. The buffer becomes busy and the character is re-output and printed. When the complete character is in the buffer, the buffer becomes full and its contents may now be read to the central processor by means of an instruction to input data from the teleprinter (see subsection 1. 2. 2). This action will cause the buffer to become empty once more.

If a key is struck or a character is sent from the printer reader when the buffer is not empty, then the character generated will be ignored and will not appear on the print-out. No further characters can be loaded into the buffer until a gap of 200 milliseconds occurs between two successive attempts to input. This ensures that if a character read from the printer reader is missed this fact cannot be overlooked.

3. 2. 2 Output

When the buffer is not busy, an instruction to output data to the teleprinter (see subsection 1. 2. 2) may be obeyed. The character will be accepted and the buffer will become busy until the character is printed.

If an output instruction is given when the buffer is full or being filled then the character already in the buffer or being loaded into the buffer will be lost.

3. 2. 3 Hold-ups

Computer instructions may be held up in the following cases:-

- (1) An output instruction issued when the buffer is busy will be held up until the transmission currently in progress is completed. This may be the output of the previous character or the acceptance of a character from the teleprinter. In the latter case the character being input will not be read to the central processor.
- (2) An input instruction issued when the buffer is not full will be held up until the buffer is full, i. e. until a key is struck or a character is read from the printer reader.

The DEMAND lamp on the control panel is lit when the 903 processor is held up waiting for a character to be input from the teleprinter. If the SELECT INPUT switch (see subsection 1. 3) is set to TELEPRINTER and a read tape instruction is held up, then this lamp is lit.

3. 2. 4 Reset

Pressing the RESET button on the 903 Control Unit will cause the teleprinter buffer to be cleared. The reader and punch buffers will not be affected (but the punch will clear itself in 10 milliseconds.)

3. 3 Teleprinter Controls

These are divided into two categories:

(1) Operational Controls

These controls allow the operation of the teleprinter to be controlled by the user. They are not involved in transferring information to or from the buffer (see Table 3).

(2) Character keys

These are situated on the keyboard and their use initiates the input of characters (see Table 4). For a diagram of the keyboard layout see Appendix 2.

Table 3 Teleprinter Operational Controls

Control	Description	Effect of Manipulation	Notes
LINE/OFF/LOCAL	Three position switch.	<p>LINE: When the switch is in this position the teleprinter is connected to the controller.</p> <p>OFF: If the switch is in this position the teleprinter is switched off.</p> <p>LOCAL: When the switch is in this position the keyboard is connected directly to the reader and punch i. e. the teleprinter is OFF-LINE.</p>	This switch must always be in the LINE position when the teleprinter is used with the 903 system.
ON OFF	Two push buttons mounted above the punch.	When the ON button is depressed the punch is switched on; the codes punched are a copy of all the codes sent to the printing mechanism either from the central processor or from the keyboard via the controller. When the OFF button is depressed the punch is switched off.	The punch copies the code sent to the printer even if it is of the wrong parity.
REL (release)	Push button to the left of the OFF button.	Frees the tape in the punch.	

Table 3 Teleprinter Operational Controls (cont'd)

Control	Description	Effect of Manipulation	Notes
B. SP (backspace)	Push button to the left of the ON button.	Backspaces the tape one character pitch for each depression.	Repeated use of this button will give rise to a tape unreadable by the printer reader or paper tape reader. One or two backspaces can, however, be used without ill effect.
START/STOP/FREE	Three position toggle switch situated below the reader.	Reader starts when this switch is in the START position and stops when the switch is returned to STOP. When it is in the FREE position tape may be moved freely in both directions.	The reader can only be started manually. Therefore it should only be started when the DEMAND lamp is on. The logic treats information entered via the reader as if it originated from the keyboard.

Table 3 Teleprinter Operational Controls (cont'd)

Control	Description	Effect of Manipulation	Notes
Reader Single Shot (not labelled)	Black push button on the right hand side of the keyboard.	Advances the tape in the reader by one character pitch for each depression.	
Alarm (Tape out) (not labelled)	Small two-way mechanism fitted to the reader.		If the tape runs out this device causes the reader to stop.

Table 4 Teleprinter Character Keys

Control	Effect of Manipulation	Notes
42 Print Keys	Depressing any one of these keys will cause the code for the character marked on it to be sent to the buffer.	Some of these keys have shift characters which are produced by depressing the shift key, and, while holding it down, depressing the required character key.
RETURN (carriage return) and LINE FEED	Depressing these keys in the order RETURN, LINE FEED will position the mechanism ready to start printing at the beginning of a new line.	
Space Bar (situated below character keys)	Depressing the Space Bar causes the space code to be sent to the buffer.	
SHIFT (Two keys at right and left of the keyboard)	Shift characters are described on the upper half of some of the character keys. To produce shift characters it is necessary to depress the shift key together with the key on which the shift character is found. Depressing the shift key inverts bits 5 and 8 of the character code being sent to the buffer. Shift cannot be locked.	Keys which do not have shift characters are locked when the shift key is depressed. See Appendix 1 for the code and Appendix 2 for the keyboard layout.

Table 4 Teleprinter Character Keys (cont'd)

Control	Effect of Manipulation	Notes
<p>CTRL (control key at the left of the keyboard)</p>	<p>When used with certain other keys the control key punches codes in the range 0-31 (see Appendix 1, Table 1). The effect of the control key is to delete bit 7 and modify bit 8 to retain even parity. The code produced by the control key does not cause a character to be printed although it is reproduced by the punch.</p>	<p>In certain cases it is necessary to depress both the shift and control keys; e. g. to produce a code with the value 30 it is necessary to depress the shift key, the control key and, while holding them down, the N key. (See Appendix 1 Table 1). Keys which do not have control characters are locked when the control key is depressed.</p>
<p>DELETE</p>	<p>The delete code is punched.</p>	<p>To delete a character which has been punched on tape, the tape should be backspaced until the required character is obtained and then the DELETE key should be depressed. The DELETE code is punched in place of the character to be erased.</p>
<p>REPT (Repeat)</p>	<p>Depressing the REPT key together with one of the print keys causes the appropriate character to be printed and punched continuously until either key is released.</p>	

Table 4 Teleprinter Character Keys (cont'd)

Control	Effect of Manipulation	Notes
RUNOUT	While this key is held down the tape runs through the punch. Sprocket holes are punched and a stream of zero characters is sent to the buffer.	
TAB (Tabulation)	When this key is depressed simultaneously with the control key the tabulation code is punched. Although this has no effect on the teleprinter, whose printing mechanism has no tabulation facility, the code will be reproduced on tape and will be effective on tape reading equipment which has this facility.	Although TAB is inscribed on the upper half of the I key it is a control and not a shift character.
HALT	When this key is depressed simultaneously with the control key the halt code is punched. This code has no effect on the teleprinter reader which can only be stopped manually.	Although HALT is inscribed on the upper half of the T key it is a control and not a shift character.

3. 4 Physical Details

Paper Width

Standard rolls of paper of length $8\frac{1}{2}$ inches, outer diameter 5 inches and inner diameter 1 inch are used.

Tear-off Strip

A perspex tear-off strip is fitted.

Platen

An $8\frac{1}{2}$ inch friction feed platen is normally fitted but an $8\frac{1}{2}$ inch pin feed platen may be fitted as an option.

Line Spacing

Line spacing is normally 6 to the inch. It is possible to adjust the teleprinter internally to make the line spacing 3 to the inch.

Line Length

The line length is 6.9 inches (69 characters).

Type

The type pitch is 10 characters to the inch. The numeral zero is thin and rounded and the letter 'O' is squared.

Speed

The maximum typing speed is 10 characters per second.

	Weight		Height		Depth		Width	
	kg	lb	cm	in	cm	in	cm	in
Teleprinter and Stand	25.2	56	83.5	32.8	47.0	18.5	55.8	22

3.5 Codes

Provision is made for the teleprinter to generate 96 codes. Of these, codes between 1 and 26 are produced by using the CTRL key in conjunction with a character key; code 0 and codes between 27 and 31 are produced by using the control and shift keys in conjunction with a character key. Punching of these codes is explained in Appendix 1, Table 1. All other codes are listed in Table 2.

Codes for lower case alphabet characters i. e. codes between 97 and 122, and codes 96 and 123-126 cannot be produced by the teleprinter. However, if these codes are fed into the printer reader in the form of a tape produced by a device which does punch these codes, they are interpreted by the printer as upper case letters and printed accordingly. Code 96 will be printed as ` (grave accent) and codes 97-122 will be printed as A-Z respectively; code 123 prints [and codes 124-126 are ignored.

The codes are punched on 8-track tape; tracks 1-7 are punched with the binary value of the code, and track 8 with the parity bit (even parity is required). The keyboard always produces the correct parity but it is not necessary to ensure that the code output to the printer is of correct parity as the mechanism responds only to the first seven bits of any code. The printer punch, when in use, copies the code sent to the printer, even if it is of the wrong parity.

Appendix 1: LIST OF CODES

Table 1: Numerical Codes in the range 0-31

In the following table, the letter outside the brackets e.g. 'P' or 'A' denotes the character key to be depressed. Within the brackets, 'S' and 'C' indicate that the shift and control keys respectively must be depressed simultaneously with the character key to produce the specified code, e.g. depressing A and CTRL will produce code 1.

Keys Pressed	Binary Value	Decimal Value	Character Printed
P(S, C)	00000000	0	Blank
A(C)	10000001	1	-
B(C)	10000010	2	-
C(C)	00000011	3	-
D(C)	10000100	4	-
E(C)	00000101	5	-
F(C)	00000110	6	-
G(C)	10000111	7	-
H(C)	10001000	8	-
TAB i. e. I(C)	00001001	9	-
LINE FEED	00001010	10	-
K(C)	10001011	11	-
L(C)	00001100	12	-
RETURN	10001101	13	-
N(C)	10001110	14	-
O(C)	00001111	15	-
P(C)	10010000	16	-
Q(C)	00010001	17	-
R(C)	00010010	18	-
S(C)	10010011	19	-
HALT i. e. T(C)	00010100	20	-
U(C)	10010101	21	-
V(C)	10010110	22	-
W(C)	00010111	23	-
X(C)	00011000	24	-
Y(C)	10011001	25	-
Z(C)	10011010	26	-
K(S, C)	00011011	27	-
L(S, C)	10011100	28	-
M(S, C)	00011101	29	-
N(S, C)	00011110	30	-
O(S, C)	10011111	31	-

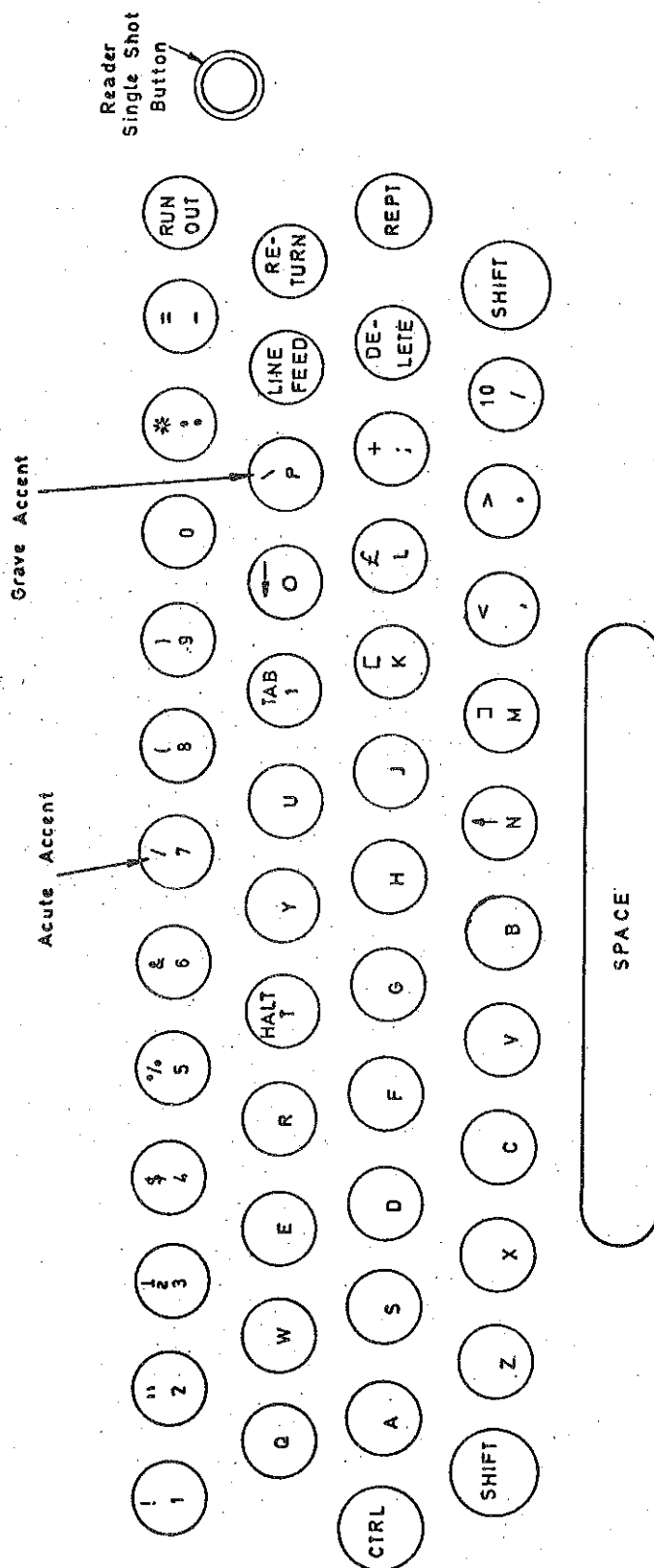
Table 2: Numerical codes in the range 32-95 and 127

(S) beside a character indicates that the shift key must be depressed simultaneously with the character key to produce the code. These characters are marked on the upper half of the key.

Keys Pressed	Binary Value	Decimal Value	Character Printed
Space bar	10100000	32	Space
! (S)	00100001	33	!
" (S)	00100010	34	"
½ (S)	10100011	35	½
\$ (S)	00100100	36	\$
% (S)	10100101	37	%
& (S)	10100110	38	&
' (S)	00100111	39	'(acute)
((S)	00101000	40	(
) (S)	10101001	41)
* (S)	10101010	42	*
+ (S)	00101011	43	+
,	10101100	44	,
-	00101101	45	-
.	00101110	46	.
/	10101111	47	/
0	00110000	48	0
1	10110001	49	1
2	10110010	50	2
3	00110011	51	3
4	10110100	52	4
5	00110101	53	5
6	00110110	54	6
7	10110111	55	7
8	10111000	56	8
9	00111001	57	9
:	00111010	58	:
;	10111011	59	;
< (S)	00111100	60	<
= (S)	10111101	61	=
> (S)	10111110	62	>
10(S)	00111111	63	10

Keys Pressed	Binary Value	Decimal Value	Character Printed
` (S)	11000000	64	` (grave)
A	01000001	65	A
B	01000010	66	B
C	11000011	67	C
D	01000100	68	D
E	11000101	69	E
F	11000110	70	F
G	01000111	71	G
H	01001000	72	H
I	11001001	73	I
J	11001010	74	J
K	01001011	75	K
L	11001100	76	L
M	01001101	77	M
N	01001110	78	N
O	11001111	79	O
P	01010000	80	P
Q	11010001	81	Q
R	11010010	82	R
S	01010011	83	S
T	11010100	84	T
U	01010101	85	U
V	01010110	86	V
W	11010111	87	W
X	11011000	88	X
Y	01011001	89	Y
Z	01011010	90	Z
[(S)	11011011	91	[
£ (S)	01011100	92	£
] (S)	11011101	93]
↑ (S)	11011110	94	↑
← (S)	01011111	95	←
DELETE	11111111	127	

Appendix 2: KEYBOARD LAYOUT



Appendix 3: ON LINE ADAPTOR FACILITY

General Description

The On Line Adaptor is an optional unit which prevents the computer from being held up for more than $2 \mu\text{s}$ if the Paper Tape Station and Teleprinter devices are busy or not available. This facility is most useful where a computer is left unattended for long periods such as in the process control or data logging fields. The Adaptor is also able to indicate the availability of the devices to the central processor.

The unit consists of one logic board which is fitted in the basic controller logic rack within the 903 computer desk. Conversion of an existing system to incorporate the unit is possible, but should only be carried out by a qualified engineer.

The unit functions in the Auto mode and when the ON LINE switches on the computer control unit are set to Manual, it is rendered non-effective.

Hold-Up Response

If a device becomes available within $2 \mu\text{s}$ of a data transfer signal being output from the central processor the instruction is carried out normally.

If the device remains busy, e.g. paper tape replacement or mechanical breakdown, a pseudo reply is generated by the Adaptor and sent to the central processor within $2 \mu\text{s}$; the control logic is also inhibited from making a data transfer, thus allowing the central processor to continue with its main program.

Device Availability

The Adaptor is also designed to generate a set of four separate signals which indicate the availability of each device i.e. Paper Tape reader and punch and the input and output of the Teleprinter. This facility is only possible when the unit is used in conjunction with a special electronics unit which can automatically sample the state of the various devices.

The special electronics unit must be connected to the signal line for each of the devices and when it detects that a device is not busy, an INTERRUPT must be generated. Then, in accordance with the priority level assigned to the special electronics unit, the central processor deals with the INTERRUPT in the usual way.

NOTE: The special electronics unit is not a catalogue item and therefore not generally available.

Appendix 4: ON-LINE PROGRAM FACILITY

General Description

This specification describes a facility for operating the 903 Paper Tape Station in either an On-line mode or an Off-line mode. The mode of operation is determined by program control.

When operating in an Off-line mode, the processor is held up until the device required is ready. In an On-line mode the processor will not be held up for more than 2 μ s whatever the state of the device required.

Instructions are available to input a status word from the Paper Tape Station to determine whether the selected devices are ready, and to output a control word to put the Paper Tape Station On-line if it is undesirable to hold up the program. When in the On-line mode, if a device is addressed when it is busy, then the characters input to the processor are undefined and any characters output to the device are lost.

All other facilities will be as defined for a standard 903 Paper Tape Station.

The On-line program facility is an optional feature and is not included in the standard 903 Paper Tape Station.

Instructions

The following operations are possible using the adaptor board:

- (1) input a status word to determine availability of devices.
- (2) output a control word to set the P. T. S. either On-line or Off-line.

The instruction to input a status word from the P. T. S. will be

15 2049

The status word input shall have the following meaning.

Bit one set	-	Reader buffer loaded.
Bit two set	-	Punch ready.
Bit three set	-	Teleprinter input buffer loaded.
Bit four set	-	Teleprinter output ready.

NOTE: The bits of the status word will only indicate the status of the selected device. When the SELECT INPUT or SELECT OUTPUT switches are set to AUTO, the status word indicates the status of the program selected device. When these switches are set to a position other than AUTO, the status word indicates the status of the operator selected device, e. g. if punch output is selected by the program, and this has been overridden by the operator selecting teleprinter output, then bits 2 AND 4 of the status word will indicate whether the TELEPRINTER is ready.

The instruction to output a control word to the P. T. S. shall be

15 6145

The control word output shall have the following meaning.

- Bit one set to 1 - Set the P. T. S. to On-line mode.
- Bit one set to 0 - Set the P. T. S. to Off-line mode.

Engineering Information

The On-line facility is provided by one logic board (Type DP. 321) which plugs into position 17 on the Paper Tape Station logic rack.

Note that an alternative On-line facility (described in Appendix 3) is also available where the On-line mode is selected by an operator switch. This manual selection facility is provided by means of an alternative board (Type DP. 04) which plugs into position 17 on the logic rack.

Appendix 5: SECOND PAPER TAPE AND/OR TELEPRINTER EQUIPMENT

General Description

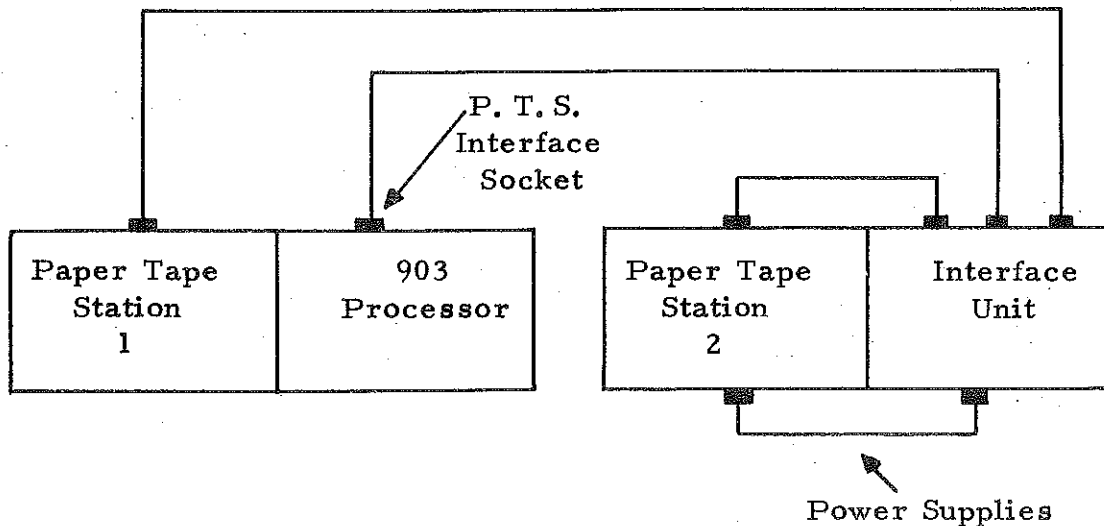
This appendix covers the provision of a second reader and/or punch and/or teleprinter to be used in conjunction with a basic 903 computer system. The extra equipment will consist of a complete 903 Paper Tape controller in a standard desk assembly and an extra unit which will perform as a T-junction fanning unit for the two paper tape controllers. The second paper tape and teleprinter system will operate in an identical manner to the basic paper tape and teleprinter station, except for the new instructions specified under Instructions.

System Configuration

The arrangement of the system will require two interdesk cables which may be up to 20 ft. long. Intradesk cable lengths will be as for the standard 903 assembly. Tape exit from both readers and punches will be to the left of the desk and this should be borne in mind when considering system layout.

Mains power will be supplied to each desk. The logic power supplies for the interface unit will be taken from the 'Test' socket of the second paper tape controller.

Cable interconnections will be thus:



Instructions

Extra program instructions will be available to specify Punch 2, Reader 2 and Teleprinter 2.

The instructions to output a character to Punch 2 will be

15 6146

and to Teleprinter 2 will be

15 6150

The instruction to input a character from Reader 2 will be

15 2050

and from Teleprinter 2 will be

15 2054

The control word to put the second controller in the On-line mode will be

15 6147

where this option is available.

The instruction to input the status word of the second controller will be

15 2051

where this option is available.

NOTE: The option mentioned above is specified in Appendix 4.

Engineering Facilities

There will be a manual selection facility fitted on the Interface Unit to enable the engineer to override program selection of controller.